Preventing Hospital Readmissions and Limiting the Complications Associated With Total Joint Arthroplasty

Abstract

Total joint arthroplasty is a highly successful surgical procedure for patients with painful arthritic joints. The increasing prevalence of the procedure is generating significant expenditures in the American healthcare system. Healthcare payers, specifically the Center for Medicare and Medicaid Services, currently target total joint arthroplasty as an area for healthcare cost-savings initiatives, resulting in increased scrutiny surrounding orthopaedic care, health resource utilization, and hospital readmissions. Identifying the complications associated with total hip and total knee arthroplasty that result in readmissions will be critically important for predictive modeling and for decreasing the number of readmissions following total joint arthroplasty. Additionally, improving perioperative optimization, providing seamless episodic care, and intensifying posthospital coordination of care may result in a decreasing number of unnecessary hospital readmissions. Identified modifiable risk factors that significantly contribute to poor clinical outcome following total joint arthroplasty include morbid obesity; poorly controlled diabetes and nutritional deficiencies; Staphylococcus aureus colonization; tobacco use; venous thromboembolic disease; cardiovascular disease; neurocognitive, psychological, and behavioral problems; and physical deconditioning and fall risk. Both clinical practice and research will be enhanced if there is standardization of defined total joint arthroplasty complications and utilization of stratification schemes to identify high-risk patients. Subsequently, clinical intervention would be warranted to address modifiable risk factors before proceeding with total joint arthroplasty.

Total joint arthroplasty (TJA) is a highly successful surgical procedure for patients with painful, arthritic joints. The prevalence of TJA has increased considerably; an estimated two million Americans are expected to receive a total hip arthroplasty (THA) or total knee arthroplasty (TKA) in 2020. The rising volume of joint arthroplasties in this country generates significant expenditures to the American healthcare system, and healthcare payers are currently targeting TJA for healthcare cost-savings initiatives. The Center for Medicare and Medicaid Services (CMS) has targeted orthopaedics, specifically TJA, for evaluation and has begun penalizing hospitals for high readmission rates.
Jencks et al² analyzed the Medicare claims data from 2003 and 2004 to determine the frequency and patterns of rehospitalization. Of the 11,855,702 Medicare beneficiaries, 19.6% were 30-day readmissions; of these patients, 70% were readmitted because of a medical condition. The cost of rehospitalization or readmission was $17.4 billion.

Section 3025 of the Affordable Care Act added Section 1886(q) to the Social Security Act, establishing the Hospital Readmission Reduction Program, effective October 1, 2012.³ The program expanded and, starting in 2014, patients admitted for elective TJA have been closely monitored for 30-day readmissions. Hospitals with unacceptable readmission rates are fined or receive a readmission payment adjustment factor. Similar to payment reductions implemented for readmitted patients with cardiopulmonary disease, the first-year payment reduction in orthopaedics is anticipated to be 1% for the fiscal year 2015, 2% in 2016, and 3% in 2017 for hospitals with unacceptable readmission rates. CMS projects that 20% of readmissions are preventable, representing an estimated annual savings of $2 billion.

Identifying the complications associated with TJA that result in hospital readmission is critically important for predictive modeling and for decreasing the number of TJA readmissions. Additionally, improving perioperative optimization, providing seamless episodic care, and intensifying posthospital coordination of care may result in a decreasing number of unnecessary hospital readmissions.

### Defining the Complications

Preventing hospital readmissions requires understanding the causes of re-admission. Frequently, postoperative complications, both medical and surgical, are associated with readmissions; however, until recently, complications following THA and TKA have not been well defined. To standardize complications for THA, The Hip Society established a THA complications work group in 2011. The goal of the work group was to develop a list of “minimum necessary” THA complications and adverse events that would result in accurate reporting of outcomes. A further goal was to develop standardized definitions for TJA complications and adverse events.

Nineteen THA complications with definitions were endorsed by The Hip Society.⁴ The list of THA complications is not comprehensive, and it excludes several conditions that could not be logistically included (Table 1). Similarly, The Knee Society previously published complications associated with total knee arthroplasty⁵,⁶ (Table 2). With a standardized, well-defined list of TJA complications, the rates of TJA will likewise approach a value that is more universally accepted. Definitions outlined by both The Hip Society and The Knee Society are used to report the incidences derived from the Centers for Medicare and Medicaid Services Limited Dataset⁷ (Table 3). Additionally, the severity of complications can vary. Stratification of complications increases clinical applicability and improves the clarity of research, as evidenced by other surgical specialties, such as general surgery⁸ and hip preservation.⁹ A modification of the hip preservation stratification system was used to stratify these complications (Table 4).

### Identifying High-risk Patients

It is logical to assume that identification and correction of modifiable risk factors associated with TJA complications will result in a reduction in hospital readmissions. Kansagara et al⁵ published the risk factors predictive of hospital readmission and grouped them into six categories: medical comorbidities, mental health, illness severity, prior medical use, functional status, and socioeconomic factors. Most studies regarding readmission risk factors, however, do not use all six of these categories. Mednick et al¹⁰ reported that the risk of reoperation following THA increased with the number of preoperative comorbidities, morbid obesity, history of corticosteroid use, and low preoperative serum albumin levels in patients with postoperative site infection, thromboembolic events, and sepsis (Table 5).

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Dr. Garvin or an immediate family member serves as an unpaid consultant to TRAK Surgical and serves as a board member, owner, officer, or committee member of the American Academy of Orthopaedic Surgeons, the American Orthopaedic Association, The Hip Society, and The Knee Society. Dr. Healy or an immediate family member has received research or institutional support from the Department of Defense, the Agency for Healthcare Research and Quality, and the Patient-Centered Outcomes Research Institute; has received royalties from DePuy; serves as a paid consultant to DePuy; and serves as a board member, owner, officer, or committee member of the American Orthopaedic Association, the Accreditation Council for Graduate Medical Education, the Association of American Medical Colleges, the Council of Faculty and Academic Societies, Health Volunteers Overseas/Orthopaedics Overseas, The Hip Society, and the South Carolina Orthopaedic Association. Dr. Iorio or an immediate family member has received research or institutional support from OrthoSensor and Pacira Pharmaceuticals and serves as a board member, owner, officer, or committee member of The Hip Society and the American Association of Hip and Knee Surgeons. Neither Dr. Yu nor any immediate family member has received anything of value from or has stock or stock options held in a commercial company or institution related directly or indirectly to the subject of this article.

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TJA patients commonly have risk factors and comorbidities that raise the risk of complications and adverse outcomes (Table 6). A logical step to decrease the risk of readmission is to identify which factors are modifiable and, for those that are, determine whether the modifications result in a lower risk of readmission. Risk factors for infection have been well established for TJA patients.11,12 Maoz et al11 identified...
## Table 2

<table>
<thead>
<tr>
<th>Complication</th>
<th>Definition of Complication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bleeding</td>
<td>Postoperative bleeding requiring surgical treatment</td>
</tr>
<tr>
<td>Wound complication</td>
<td>Failure of wound healing requiring reoperation or a change in TKA protocol</td>
</tr>
<tr>
<td>Thromboembolic disease</td>
<td>Symptomatic thromboembolic event requiring more intensive, nonprophylactic anticoagulant or antithrombotic treatment during the first 3 months after index TKA</td>
</tr>
<tr>
<td>Neural deficit</td>
<td>Postoperative neural deficit (sensory or motor) related to the index TKA</td>
</tr>
<tr>
<td>Vascular injury</td>
<td>Intraoperative vascular injury requiring surgical repair, bypass grafting, or stenting (compartment syndrome or amputation should be reported)</td>
</tr>
<tr>
<td>Medial collateral ligament injury</td>
<td>Intraoperative or early postoperative medial collateral ligament injury requiring repair, reconstruction, a change in prosthetic constraint, revision surgery, or TKA protocol</td>
</tr>
<tr>
<td>Instability</td>
<td>Symptomatic instability reported by the patient and confirmed by laxity on physical examination as defined by The Knee Society Knee Score</td>
</tr>
<tr>
<td>Malalignment</td>
<td>Symptomatic malalignment reported by the patient and confirmed radiographically with angular deformity in the coronal plane &gt;10° from the mechanical axis</td>
</tr>
<tr>
<td>Stiffness</td>
<td>Limited ROM as reported by the patient and demonstrated in a physical examination with extension limited to 15° short of full extension or flexion &lt;90° (not applicable if preoperative arc of motion &lt;75°)</td>
</tr>
<tr>
<td>Deep periprosthetic joint infection</td>
<td>A deep periprosthetic joint infection can be diagnosed when there is a sinus tract communicating with the prosthesis, or a pathogen is isolated by culture from at least two separate tissue or fluid samples obtained from the affected prosthetic joint, or four of the following six criteria exist: elevated ESR and serum CRP concentration; elevated synovial WBC count; elevated synovial PMN; presence of purulence in the affected joint; isolation of a microorganism in one culture of periprosthetic tissue or fluid; or &gt;five neutrophils/high-power field in five high-power fields observed from histologic analysis of periprosthetic tissue at 400× magnification</td>
</tr>
<tr>
<td>Periprosthetic fracture</td>
<td>Periprosthetic fracture of the distal femur, proximal tibia, or patella (surgical or nonsurgical treatment should be recorded)</td>
</tr>
<tr>
<td>Extensor mechanism disruption</td>
<td>Disruption of the extensor mechanism (surgical repair and/or extensor lag should be recorded)</td>
</tr>
<tr>
<td>Patellofemoral dislocation</td>
<td>Dislocation of the patella from the femoral trochlea (direction of instability should be recorded)</td>
</tr>
<tr>
<td>Tibiofemoral dislocation</td>
<td>Dislocation of the tibiofemoral joint (direction of instability should be recorded)</td>
</tr>
<tr>
<td>Bearing surface wear</td>
<td>Wear of the bearing surface symptomatic or requiring reoperation</td>
</tr>
<tr>
<td>Osteolysis</td>
<td>Expansile lytic lesion adjacent to one of the implants &gt;1 cm in any one dimension or increasing in size on serial radiographs/CT</td>
</tr>
<tr>
<td>Implant loosening</td>
<td>Implant loosening confirmed intraoperatively or identified radiographically as a change in implant position or a progressive, radiolucent line at the bone-cement or bone-implant interface</td>
</tr>
<tr>
<td>Implant fracture or tibial insert dissociation</td>
<td>Implant fracture or dissociation of the tibial insert from the tibial implant</td>
</tr>
<tr>
<td>Reoperation</td>
<td>Return to the operating room related to the index TKA (reasons for reoperation should be recorded)</td>
</tr>
<tr>
<td>Revision</td>
<td>Revision of one or more of the TKA implants (femur, tibia, tibial insert, patella)</td>
</tr>
<tr>
<td>Readmission</td>
<td>Admission to the hospital for any reason during the first 90 days after TKA (reasons for admission and relation to index TKA should be recorded)</td>
</tr>
<tr>
<td>Death</td>
<td>Death occurring for any reason during the first 90 days after TKA (cause of death and relation to index TKA should be recorded)</td>
</tr>
</tbody>
</table>

CRP = C-reactive protein, ESR = erythrocyte sedimentation rate, PMN = polymorphonuclear neutrophil, ROM = range of motion, TKA = total knee arthroplasty, WBC = white blood cell
eight “modifiable” risk factors that significantly contribute to poor clinical outcome following TJA: morbid obesity; poorly controlled diabetes and nutritional deficiencies; *Staphylococcus aureus* colonization; tobacco use; venous thromboembolic disease; cardiovascular disease; neurocognitive, psychological, and behavioral problems; and physical deconditioning and fall risk.

### Modifiable Risk Factors

#### Obesity

The link between obesity, diabetes, metabolic syndrome, and osteoarthritis is well-documented. As obesity rates rise and patients continue to live longer, the need for TJA will likewise increase. The rising incidence of obesity is occurring in parallel with the increasing demand for TJA. In the United States, the age-adjusted prevalence of obesity for 2010 was 36% for both men and women and is a major healthcare concern.

Obese patients tend to have higher pain scores, experience slower recovery from pain, and have greater difficulty with functional restoration. Significant evidence suggests that although obese patients often experience improvements from TJA in regard to mobility, pain, and lower limb function, they are at an increased risk for immediate and long-term postoperative complications, including infection (both superficial and deep). Contributing factors leading to increased infection rates include longer surgical time, difficult surgical exposure, decreased vascularization of adipose tissue, and weakened immune response. When these factors are combined with coexisting immunosuppressive morbidities, such as diabetes, prevention of infection becomes even more difficult.

Obesity has consistently been proven to contribute independently to poorer outcomes, higher costs, and decreased patient satisfaction overall. Gillespie and Porteous reviewed TKA implant survivorship differences between nonobese and obese patients at 7 years (98.7% versus 87.8%, respectively) and at 10 years (98.5% versus 92.7%, respectively). The differences between nonobese and obese patients younger than 60 years were even more impressive (88.6% versus 59.5%). Bozic et al estimated the cost of managing these outcomes for the year following the 90-day perioperative period to be >$11,000 per patient.

Preoperative management of obesity is an important component of surgical optimization. Although obesity has been linked to many deleterious effects,
as described earlier, the process of preoperative weight-loss management remains controversial. Bariatric surgery has been historically successful in significantly reducing the body mass index (BMI) of morbidly obese patients; however, the clinical effects and timing of bariatric surgery remain unclear in the literature. Severson et al. found that patients who underwent bariatric surgery >2 years before undergoing TKA experienced shorter anesthesia time, decreased surgical time, and decreased tourniquet time; however, 90-day complication rates and outcomes did not differ significantly. A study by Inacio et al. failed to detect any statistical differences in postoperative complications between TJA patients who underwent bariatric surgery and TJA patients who were candidates for, but did not undergo, bariatric surgery. The authors further suggested that bariatric surgery was associated with a higher revision rate and thus may not provide the expected dramatic improvements in surgical outcomes.

Obesity is a major risk factor for both intraoperative and postoperative adverse events. Despite these risks, there is no absolute BMI cutoff that isolates patients at high risk. A cutoff BMI of 40 may be reasonable, although Toman et al. identified a BMI of 37.5 as a predictor for tibial failure in TKA. Consequently, morbid obesity should be identified as a factor for increased risk and poor outcome after TJA, and preoperative intervention is warranted before surgery. Although there is conflicting literature surrounding the effect and timing of bariatric surgery, it is evident that obese patients who participate in a nonsurgical means of weight reduction benefit from both a surgical and a functional outcome perspective. Emerging evidence correlating the severity of obesity with outcome will lead to a more stratified approach to the obese TJA patient.

Diabetes

Diabetes mellitus (DM) is a significant surgical risk factor that can substantially increase the incidence of perioperative complications. Approximately 8% of all patients undergoing TJA in the United States have been diagnosed with DM (type 1 or type 2), thus representing a sizable population of at-risk patients.

Patients with uncontrolled DM have a higher incidence of complications compared with both controlled diabetic and nondiabetic patients. Patients with uncontrolled DM undergoing TJA have significantly increased odds ratios (OR) of cerebral vascular accident (OR, 4.1), urinary tract infection (OR, 2.5), paralytic ileus (OR, 2.4), infection (OR, 2.3), postoperative hemorrhage (OR, 1.8), transfusion (OR, 1.8), and death (OR, 2.7) compared with nondiabetic patients. These findings accentuate the importance of obtaining control of the patient’s DM to significantly reduce his or her risk prior to TJA.

Although perioperative hemoglobin A1c has been used to predict the risk of complications, studies examining perioperative hemoglobin A1c as a predictor for risk in diabetic patients undergoing TJA showed an insignificant correlation with infection. Instead, perioperative hyperglycemia was found to be a more effectual measure of risk for TJA patients. Hyperglycemia can result from administration of dextrose-containing fluids, surgical stress, and underlying, uncontrolled DM. Perioperative hyperglycemia may be a more accurate predictor of complication risk, specifically of postoperative infection. Patients with postoperative infections have been shown to have increased blood glucose levels both pre- and postoperatively. Moreover, hyperglycemia levels >200 mg/dL evident on postoperative day one result in a twofold increased risk of infection. Even nondiabetic patients saw a threefold increase in infection risk with blood glucose levels >140 mg/dL. Thus, increased blood glucose levels in the perioperative setting indicate an increased risk of complications following TJA. Specific attention to tighter control of glucose level during the perioperative period is a prudent part of TJA patient management and it may contribute to decreasing future complications and readmissions by improving patient outcomes.

Staphylococcus aureus Colonization

Methicillin-sensitive Staphylococcus aureus (MSSA) and methicillin-resistant Staphylococcus aureus (MRSA) detection and decolonization is one modality of surgical site
Infection (SSI) prevention that has gained momentum. Twenty percent to 30% of the population are persistent nasal carriers for MSSA, and 1% to 5% are carriers for MRSA; correspondingly, *S. aureus* is the most common organism responsible for SSIs in patients undergoing TJA. Typically, patients are screened for MSSA/MRSA via a nasal swab up to 3 months before surgery. Those found to be carriers are instructed to perform chlorhexidine showers and apply 2% intranasal mupirocin ointment twice daily up to a week before the day of surgery. Prophylactic antibiotics (ie, cephalosporin and glycopeptide) for TJA should include coverage of both MSSA and MRSA.

Maoz et al described the effects of implementing a staphylococcal detection and decolonization protocol in an effort to decrease SSIs. For primary THA, factors that significantly increase the risk of SSI include smoking, American Society of Anesthesiologists scores $\geq 2$, BMI $\geq 40$, and surgical time $\geq 115$ minutes. For primary TKA, significant predictors of SSI include female sex, smoking, concomitant pulmonary disease, and colonization with MSSA/MRSA. Patients with multiple risk factors, including *S. aureus* colonization, were at further increased risk for SSIs (Table 5).

Specifically targeting MRSA colonization has proven to be an effective prevention scheme. Mehta et al demonstrated that implementation of the preoperative staphylococcal decolonization protocol saw a MRSA prevalence density rate of 1.23 per 1,000 patient days drop to 0.83 per 1,000 patient days. Decolonization strategies have proven to be successful, and clinical outcomes have positively correlated with a decreasing prevalence of colonization. Hadley et al compared the effect of a MRSA decolonization protocol on the rates of SSIs in patients who underwent primary TJA and found that staphylococcal decolonization led to a 13% decrease in deep SSIs. The literature supports implementing *S. aureus* decolonization protocols to reduce the risk of SSIs.

*S. aureus* decolonization protocols are also cost effective. Courville et al analyzed the cost effectiveness of preoperative use of mupirocin in the prevention of *S. aureus* colonization. The authors showed that empirical treatment with mupirocin ointment or the use of a screen-and-treat strategy before TJA resulted in significant cost savings by reducing the number of SSIs. Recent studies show similar results and confirm that these prevention programs lead to decreased rates of infection, complications, and readmission.

**Smoking**

Tobacco dependence, a relevant and leading cause of death in the United States, carries an estimated cost of $183 billion per year in medical care and lost productivity. Despite efforts to control and raise awareness about the harmful effects of tobacco, 21% to 24% of patients undergoing THA or TKA are active tobacco users.

The harmful effects of tobacco are well documented. Møller et al concluded that tobacco use was the single most important risk factor for the development of postoperative complications, including increased wound-related and cardiopulmonary complications, intensive care unit admission, and increased length of hospital stay. Examining the impact of tobacco use and BMI on the length of hospital stay and the risk of short-term postoperative complications, Sadri Azodi et al reported an increased risk of 43% to 56%. Furthermore, Lavermia et al demonstrated that the cost burden of treating patients who actively use tobacco is significantly higher; tobacco users accrued higher hospital costs than did non-smokers ($35,628 versus $30,706, respectively).
conducted the first randomized clinical trial of the risk-reducing effects of tobacco-cessation intervention programs for patients undergoing THA or TKA. The authors demonstrated that preoperative tobacco cessation programs that were begun 6 to 8 weeks before surgery significantly reduced postoperative complications, with the risk reduction most evident in wound-related complications. The Gold Standard Program for Tobacco Cessation (which included education, counseling, and nicotine replacement therapy) resulted in reduced risks for TJA and had further positive effects on the continued cessation rate at 1 year postoperatively. 33 Thomsen et al 34 conducted a meta-analysis of 11 randomized clinical trials on the effects of tobacco cessation interventions, which included TJA patients, and showed similar results. In addition to proven health benefits, tobacco cessation offers a substantial economic incentive for both the patient and the hospital. Katz et al 38 investigated the cost effectiveness of an intensive tobacco dependence intervention based on self-determination theory and found that the overall incremental cost-effectiveness ratio was a savings of $1,258 per quality-adjusted life year.

Preoperative tobacco cessation programs in TJA patients have demonstrated that successful management of a patient’s smoking status is beneficial to his or her health and clinical outcomes as well as cost-beneficial for the patient, payer, and hospital and for society overall. Explaining that cessation or decreased tobacco use can help achieve improved TJA results may provide further motivation in patients who have failed previous cessation efforts. Implementation of a strong tobacco-cessation initiative, especially for elective TJA patients, can be a worthwhile measure in terms of both outcome and cost effectiveness.

Venous Thromboembolic Disease
Following TJA, perioperative cardiac events, stroke, and venous thromboembolic disease (VTED) constitute the predominant major nonorthopaedic complications. Contemporary thromboprophylaxis has reduced the overall rate of symptomatic deep vein thrombosis to < 5% after THA and 20% after TKA, whereas symptomatic pulmonary emboli (PE) occur in 1% to 2% of TJA patients, with fatal PE in 0.1% to 0.5%. However, symptomatic in-hospital thromboembolic events (0.53%), namely DVT (0.26%) and PE (0.14%), represent < 15% of all venous thromboembolisms (VTEs) (2% to 5%) that occur after THA; even with contemporary anticoagulation prophylaxis, 85% of events occur after discharge. 35 Many new anticoagulation agents have been introduced since the last National Institutes of Health conference on VTED more than 25 years ago; however, the evidence for prevention of fatal PE after TJA has changed very little. Randomized clinical trials have demonstrated a dramatic reduction in lower limb clots from the use of potent new anticoagulants, without a similar reduction in fatal PE. Specifically, newer anticoagulants (ie, fractionated heparins, synthetic pentasaccharide, and factor Xa and direct thrombin inhibitors) have all demonstrated substantial efficacy in reduction of VTED when used as primary chemoprophylaxis following TJA. However, despite their efficacy, these newer anticoagulants have also been uniformly associated with a substantial perioperative bleeding risk. Other prophylactic agents, specifically low-intensity warfarin and aspirin, have been associated with a prevalence of residual venographic clot that is up to five times greater than that of newer agents; however, they offer comparable clinical PE rates with the benefit of a two- to threefold reduction in major bleeding complications. 36

American Academy of Orthopaedic Surgeon guidelines suggest that patients at high risk for VTE and cardiovascular disease should undergo preoperative screening to determine whether venous prophylaxis is warranted. 37 However, specific details concerning the extent and duration of chemoprophylaxis for this high-risk population remain to be determined. The ideal VTE prophylaxis is a balance between the risk of death from PE and major hemorrhage, the morbidity of bleeding associated with anticoagulation, and the preferences and risk tolerances of individual patients. There is a need to establish a standardized, risk-stratified approach in individualizing thromboprophylaxis management, thereby effectively lowering the complication rate in high-risk TJA patients while preventing complications associated with overly aggressive anticoagulation measures in lower-risk patients.

Cardiovascular Disease
An aging population with increasingly prevalent cardiovascular disease requires careful attention to the management of these comorbid conditions. Perioperative cardiovascular events (eg, myocardial infarction, stroke, VTE) are a major cause of morbidity, mortality, and increased length of hospital stay in patients undergoing orthopaedic procedures. 38 Despite a relatively low incidence in the general joint arthroplasty population, cardiovascular complications are detrimental to outcomes and carry a significant cost burden to the healthcare system. Consequently, high-risk patients must be carefully managed, and a perioperative strategy...
Preventing Hospital Readmissions and Limiting the Complications Associated With Total Joint Arthroplasty

Neurocognitive, Psychological, and Behavioral Problems

Strong evidence exists that modifiable psychological risk factors are associated with low treatment adherence and poor outcomes in patients with musculoskeletal disorders. It is estimated that approximately 30% of TJA patients report high psychological distress before surgery. In addition, adverse surgical outcomes can have a significant physiologic, functional, and psychological effect, further complicating the patient’s postoperative course.

Psychological factors, such as catastrophizing (i.e., imagining the worst), negative mood, perceived disability, negative pain beliefs, and low self-efficacy, have been shown to be predictive of outcomes, such as pain relief, function, and quality of life, in patients undergoing TJA. Poorly compensated individualized pain beliefs and emotional responses are important determinants of patient-centered outcomes and should be included in a preoperative risk modification program. Pain, especially when catastrophically expressed, has also been identified as an important psychological issue in TJA. Witvrouw et al reported that catastrophizing and depression predicted a longer postoperative length of hospital stay. Berge et al demonstrated in a randomized controlled trial that patients experienced a significantly reduced overall pain experience when enrolled in a preoperative pain management program that included arthritis education and cognitive behavioral therapy (CBT).

CBT, derived from well-established modes of psychotherapy, may be effectively used to address modifiable psychological risk factors in patients with musculoskeletal disease. This approach increases patients’ sense of self-efficacy and empowers them to take control over their pain and pain-related distress as well as diverting a focus on pain in favor of meaningful activities. Keele et al illustrated positive effects of CBT for patients with osteoarthritis, reporting improved coping skills, reduced intensity of perceived pain, and decreased psychological disability. It is reasonable to conclude that TJA patients can benefit from some type of psychological intervention when ineffective psychological coping skills put them at risk for poor outcomes. Screening tools, such as the Medical Outcomes Study 12-Item Short Form, Mental Component Summary, or Pain Catastrophizing Scale, can identify “at-risk” patients. Patients may then be offered CBT to better address concerns, positively modify their outlook toward upcoming surgery, and perhaps influence outcome and satisfaction rates.

Physical Deconditioning and Comorbidities Affecting Ambulation

Preoperative physical conditioning, as measured by ambulatory status, other joint involvement, and general mobility, is an important predictor of outcome following TJA. Patients with disabilities and coexisting musculoskeletal, rheumatologic, and neuromuscular diseases that lead to ambulatory mobility problems are at increased risk of extended inpatient hospital and rehabilitation stay. Osteoarthritis can be a debilitating disease; therefore, it is important for the orthopaedic surgeon to address any limiting factors that affect the patient’s ability to exercise and rehabilitate before and after TJA surgery.

Programs designed to increase preoperative physical conditioning, also known as “prehabilitation,” have been shown to increase postoperative function and independence and hasten return to preoperative levels of function as well as decrease length of hospital stay and the need for inpatient rehabilitation. Snow et al found that the use of preoperative physical therapy (PT) was associated with a 29% decrease in post-acute care services in TJA patients. This resulted in an adjusted cost savings of $1,215 per patient episode, stemming from a reduction in the use of skilled nursing facilities, inpatient rehabilitation, and home healthcare services.

Although the concept of prehabilitation can seem beneficial in theory, convincing patients with arthritis to participate in PT may provoke unnecessary pain, thus reducing their compliance and the effectiveness of the program. Additionally, endorsing preoperative PT sessions limits the amount of possible postoperative PT sessions that are covered by certain payer services, such as Medicare. The greatest clinical and cost benefit is experienced during the preoperative clinical encounter in which the orthopaedic surgeon determines which patients will substantially benefit from prehabilitation and then prescribes targeted, individualized therapy to address specific areas of deficiency, such as preoperative range of motion or
vastus medialis obliquus muscle atrophy. Use of a one-time educational session, instructional videos, or referrals to websites helps increase patient participation and is cost-beneficial. Thorstensson et al reported that an individualized, home exercise program designed by the orthopaedic surgeon and the physiotherapist in which the patient is strongly encouraged to participate at his or her own, self-driven pace resulted in high patient participation and satisfaction rates.

**Stratifying Patients With Risk Factors for Hospital Readmission**

Because comprehensive studies have shown that it is very difficult to decrease readmissions for high-risk patients, we recommend stratifying patients based on their readmission risk factors so that their hospital readmission is risk-adjusted and the hospital and surgeon are not penalized for or discouraged from providing care for the high-risk patient population. A recent report detailed the Medicare Quality Improvement Organization that intervened in 14 communities with the purpose of reducing readmissions by improving care transition. The study failed to demonstrate an improvement or a significant difference in the rate of all-cause readmission as a proportion of hospital discharges, despite improvement in care transitions for these patients. Brown et al determined that the unexpected result teaches an important lesson, “…targeting the performance of one medical center service can change behavior that can affect the performance of other services.”

**Summary**

Robust evidence shows that a comprehensive program focusing on the risk factors associated with hospital readmission may result in fewer hospital readmissions. Large multi-institutional studies are encouraged to determine whether this process is successful. It is hoped that there are not unintended consequences of this program. Difficult medical problems can be managed in today’s healthcare climate, and complex surgery can be performed successfully in these high-risk patients. It is imperative that the payment system not be incentivized to avoid these high-risk patients, while the value proposition is encouraged such that all stakeholders are rewarded for optimizing the risk profile.

Although some of these modifiable risk factors may be longstanding and recalcitrant to change, patients may express a renewed interest in addressing them if any of the factors stands in the way of obtaining a TJA, a procedure patients hope will result in dramatic changes in pain, physical function, and quality of life. The prospect of undergoing TJA may therefore provide an opportunity (ie, teachable moment) to identify and manage such modifiable risk factors through shared decision making. All primary care and specialty physicians involved in the preadmission clearance process can participate in decreasing these risk factors preoperatively. The concept of a perioperative orthopaedic surgical home to optimize patients preoperatively is a logical way to address these patients. By implementing risk factor optimization programs, it may be possible to decrease complications after TJA surgery and lower readmission rates.

**References**

Evidence-based Medicine: Levels of evidence are described in the table of contents. In this article, references 14, 17, 21, and 27 are level II studies. References 10, 12, 19, and 20 are level III studies. Reference 11 is a level IV study. Reference 5 is level V expert opinion.

References printed in **bold type** are those published within the past 5 years.

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46. Snow R, Granata J, Ruhl AV, Vogel K, McShane M, Wasielewski R: Associations between preoperative physical therapy and post-acute care utilization patterns and cost

